

# **Institute of Actuaries of India**

## **GN 29**

### **Guidance Note**

**on**

### **Valuation of Interest Rate Guarantees on Exempt Provident Funds under AS15 (Revised)**

**A. Classification: Recommended Practice.**

**B. Legislation or Authority:**

1. Accounting Standard (AS) 15 Employee Benefits (Revised 2005) Issued by the Institute of Chartered Accountants of India – referred to herein as AS15 ( R)
2. GN26 issued by the Institute of Actuaries of India.
3. Professional Conduct Standards (PCS) Ver. 2.0 / 27th May 2003) issued by Institute of Actuaries of India.
4. Employees Provident Funds and Miscellaneous Provisions Act, 1952.
5. Income Tax Act, 1961 and Income Tax Rules, 1962

**C. Other Professional Guidance:**

Guidance Note 22(GN22): “Reserving for Guarantees in Life Assurance Business” issued by the Institute of Actuaries of India.

**D. Author:**

Council of the Institute

**E. Application:**

This Guidance Note applies to any actuary advising on actuarial valuation relating to Interest Rate Guarantee on Exempt Provident Funds prepared

1. As a requirement under AS15( R) and / or at the request of a client who may be an employer or a trustee of the Provident Fund;
2. By others who might be relied upon by a client/employer/insurer as a professional actuary giving professional advice.

## F. Compliance

Members are reminded that they must always comply with the PCS and this GN imposes additional requirements under specific circumstances.

### Status:

Exposure draft issued under due process in accordance with the “Principles and Procedures for issuance of of Guidance Notes (GNs)”.

Version	Effective From
1.0	01-04-2011

## G. Objectives:

1. This Guidance Note provides guidance to actuaries in performing actuarial valuations and preparing actuarial reports related to interest guarantee on Exempt Provident Funds. This Guidance Note briefly covers the valuation methods, assumptions and reporting requirements. Where applicable, the actuary is required to refer to GN26 in addition to this Guidance Note.
2. The methodologies recommended in this guidance note are
  - i. Deterministic Approach
  - ii. Option Pricing Approach
  - iii. Stochastic Modeling Approach
3. The choice of a methodology will depend upon what the actuary thinks is most appropriate under the given circumstances and also on the materiality of the value of the guarantee in the overall context.

## 1. Background

- a. Section 17 of the Employees' Provident Funds and Miscellaneous Provisions Act (EPFMP) Act, 1952 empowers the Government to exempt any establishment from the provisions of the Employees Provident Fund Scheme 1952 provided the rules of the provident fund set up by the establishment are not less favorable than those specified in section 6 of the EPFMP Act and the employees are also in enjoyment of other provident fund benefits which on the whole are not less favorable to the employees than the benefits provided under the Act. Such exemptions are for a period of 3 years and it can be revoked if the conditions applicable to such an exemption are not complied with.
- b. The rules of the provident funds set up by such establishments (referred to as exempt provident funds) generally provide for the deficiency, if any in the rate of interest on the contributions based on its return on investment as compared to the rate declared for Employees' Provident Fund by the Government under paragraph 60 of the Employees' Provident Fund Scheme, 1952 to be met by the employer. Therefore such exempt provident funds carry an embedded interest rate guarantee.
- c. Para 26(b) of AS 15 (R) Requires additional provision for the legal or constructive obligation through a guarantee, either indirectly through a plan or directly, of a specified return on contributions. Hence the need arises to value and report the interest rate guarantee as part of the Present Value of Obligations (PVO) under AS 15 (R).

## 2. Guidance on Methodologies

### a. Deterministic Approach:

This approach computes the present value of the interest rate guarantee under three interest rate scenarios: Base Case Scenario, Rising Interest Rate Scenario and Falling Interest Rate Scenario. The present value obligation [PVO] of the interest rate guarantee is set equal to the average of the present values determined under these scenarios.

The step by step procedure underlying this approach is as follows:

- a. As on the valuation date, compute the decrement adjusted remaining term of the obligations or such shorter period as the Actuary may consider to be appropriate [referred to as "appropriate term" hereafter]
- b. Find the current Government of India (GoI) Bond Yield for the appropriate term.

- c. Determine the average historic yield on the investment portfolio backing the PF obligations and the remaining term to maturity of this portfolio.
- d. Find the current GoI Bond Yield for a term equal to the remaining term to maturity of the above investment portfolio.
- e. Compute the difference between the average historic yield and the GoI Bond Yield. This difference represents the yield spread on the investment portfolio.
- f. Add the yield spread to the GoI Bond Yield determined in (b) to determine the expected investment return
- g. Compare this expected investment return with the guaranteed rate of interest and compute the present value of the interest rate guarantee using the formula:

(Expected Investment Return – Guaranteed Rate of Interest)\* PF accumulation \* the Present Value Annuity Factor for a term equal to the appropriate term

If the expected investment return exceeds the guaranteed rate of interest the Present Value of the Interest Rate Guarantee will be set equal to zero.

- h. Consider a 100 Basis Points (BP) upward shift in the yield curve and compute the present value of the interest rate guarantee using the formula:

(Expected Investment Return + 100 BP – Guaranteed Rate of Interest)\* PF accumulation \* the Present Value Annuity Factor for a term equal to the appropriate term.

If the expected investment return +100 BP exceeds the guaranteed rate of interest, the present value of the interest rate guarantee will be set equal to zero.

- i. Consider a 100 BP downward shift in the yield curve and compute the present value of the interest rate guarantee using the formula:

(Expected Investment Return – 100 BP – Guaranteed Rate of Interest)\* PF accumulation \* the Present Value Annuity Factor for a term equal to the appropriate term.

If the expected investment return minus 100 BP exceeds the guaranteed rate of interest, the present value of interest rate guarantee will be set equal to zero.

- j. The discount rate used for the determining the present value in steps (g), (h) and (i) will be determined in accordance with the Para 78 of the AS 15 (R).
- k. The PVO of the interest rate guarantee will be equal to the average of the present values determined in (g), (h) and (i) provided the PF trust retains the surplus interest earning for funding future interest rate shortfalls.
- l. The PVO of the interest rate guarantee will be equal to the average of the present values determined in (g) and (i) provided the PF trust does not retain the surplus interest earning for funding future interest rate shortfalls.
- m. If the PF Trust retains the amount earned in excess of the guaranteed rate in a separate account ( which may be called “Surplus Account” ) to finance the future shortfalls, then the additional liability would be the PVO as determined in step (k) less the fair value of the Surplus Account. In case the fair value of the Surplus Account is higher than the PVO calculated as above, the additional liability may taken as Nil.

**b. Option Pricing Approach:**

- a. This approach uses the modified version of the Black Scholes Option Pricing Model for determining PVO of the interest rate guarantee. This approach provides for the stochastic behavior of future interest rates by assuming that the future interest rates follow a log-normal probability distribution
- b. Under this approach, the PVO of the Interest Rate Guarantee is set equal to the Value of the Interest Rate Floor, which is computed using the Option Pricing Model. The underlying rationale is that the interest rate guarantee obligation of the enterprise is similar to the obligation of the seller of an interest rate floor who has to compensate the buyer when the actual rate of interest [on an interest reset date] turns out to be less than the guaranteed rate.
- c. If the PF trust retains the surplus interest earnings for funding future interest shortfalls then the enterprise indirectly benefits from the surplus interest earnings which will arise if the future interest rates are higher than the guaranteed rate. In this case the PVO of the interest rate guarantee will be equal to the Value of Interest Rate Floor less the Value of the Interest Rate Cap.

If the PF Trust retains the amount earned in excess of the guaranteed rate in a separate account ( which may be called “Surplus Account” ) to finance the future shortfalls, then the additional liability would be the PVO as determined above less the fair value of the Surplus Account. In case the fair value of the

Surplus Account is higher than the PVO calculated as above, the additional liability is taken as Nil.

- d. The application of the Option Pricing Model for valuing the interest rate guarantee is illustrated with the help of a numerical example in the Appendix to this GN.

**c. Stochastic Modeling Approach:**

The steps involved in applying this approach for valuing the interest rate guarantee are as follows:

- a. Obtain the (continuously compounded) Zero coupon gilt yield curve on the balance sheet date over the decrement –adjusted expected working life time of the members of the Exempt Provident Fund or such shorter period as the Actuary may consider to be appropriate.
- b. Using the Zero coupon yield curve in conjunction with any appropriate stochastic interest rate projection model, project the short-rates [one-year forward rates] over the decrement adjusted working lifetime or such shorter period as may be appropriate. The short rates need to be adjusted for the yield-spread as defined under the Deterministic Approach.
- c. Under each of the interest rate paths, determine the present values of the shortfalls and the present value of the surpluses. A shortfall will arise in the year(s) in which the projected interest rate falls below the guaranteed interest rate and “surplus” will arise in the year(s) in which the projected interest rate is above the guaranteed interest rate.
- d. The PVO of Interest Rate Guarantee will be equal to the Present Value of the Shortfalls less the Present Value of the Surpluses if the PF trust can retain the surplus interest earnings for funding future interest shortfalls. On the other hand the PVO of the interest rate guarantee will be equal to the present value of the shortfalls if the PF trust cannot retain the surplus interest earnings for funding future interest shortfalls
- e. Rank order the “PVOs of Interest Guarantee” values obtained for the various interest rate paths starting with the “largest” PVO and ending with the “smallest” PVO. Select an appropriate point in the tail of this rank-ordered distribution and compute the CTE [Conditional Tail Expectation] at that point. The “PVO of Interest Guarantee” will be equal to this CTE.

- f. The CTE (p) is defined as the arithmetic mean of the largest 100(1-p) % PVOs from the rank-ordered PVO distribution. For example, a 95% CTE will be the arithmetic mean of the largest 5% of the PVOs.

The CTE approach is recommended because it is consistent with the approach recommended in “GN22: Reserving for Guarantees in Life Assurance Business”

- g. If the PF Trust retains the amount earned in excess of the guaranteed rate in a separate account ( which may be called “Surplus Account” ) to finance the future shortfalls, then the additional liability would be the PVO as determined above less the fair value of the Surplus Account. In case the fair value of the Surplus Account is higher than the PVO calculated as above, the additional liability may be taken as Nil.

### **3. Input Requirements**

All of the above approaches will require the following inputs for valuing the interest rate guarantee.

- Rules of the Exempt Provident Fund
- Normal Retirement Age
- Date of birth
- Date of joining
- PF Accumulation for each employee as on the valuation date
- Aggregate PF Accumulation as on the valuation date
- Three to five years data on the investment returns pertaining to the PF investment portfolio
- Attrition Rate
- Asset Data
- Fair value of Plan Assets as on the Valuation Date
- Maturity Profile of the Plan Assets

### **4. Valuation Assumptions:**

All of the above approaches will require the following valuation assumptions in addition to other normal assumptions such as mortality, withdrawal etc.

- Decrement Adjusted Remaining Term of the obligations (which in turn will depend upon the mortality assumption and the attrition rate assumption) or such shorter period as the Actuary may be consider to be appropriate

- Discount Rate to be determined in accordance with Para 78 of AS 15 (R)
- Expected Return on the PF investment Portfolio.

## **5. Disclosures**

Disclosures are optional

## Appendix

### Application of the Option Pricing Framework for Valuing Interest Rate Guarantee

#### Conceptual Framework:

The Black's model, which provides a closed form solution for the value of a floor, assumes that the interest rate  $R(k)$  follows a lognormal distribution with a specified volatility parameter. Based on this assumption, the value of the floorlet is given by the following equation:

$$V[\text{Floorlet}] = L * [t(k+1) - t(k)] * P[0, t(k+1)] * [R(F) * N(-d2) - R(k) * N(-d1)]$$

Equ (1)

Where

$L$  = notional principal amount

$t(k+1)$  = time (k+1)

$t(k)$  = time k

$t(0)$  = valuation (balance sheet) date

$R(F)$  = guaranteed rate of interest

$R(k)$  = spread adjusted forward rate at time k

$d1 = \{ \ln [R(k)/R(F)] + \sigma_k^2 * t(k) * 0.5 \}$  divided by  $\sigma_k * t(k)^{0.5}$

$d2 = d1 - \sigma_k * t(k)^{0.5}$

$\sigma_k$  = volatility parameter

$P[0, t(k+1)]$  = present value factor

$N(*)$  = cumulative normal probability values

The following numerical example illustrates the application of this equation:

**Example 1:** Consider a contract with a principal amount of Rs.100m, a tenor of one year, a floor rate of 8% pa and a life of 5 years. Let us assume that the continuously compounded Zero coupon yield curve is flat at 7% pa and the annualized volatility of the interest rates underlying the floor let is 20% pa. Suppose we have to value the floor let starting one year from now.

We have

- $t(k) = 1$
  - $t(k+1) = 2$
  - $R(F) = 0.08$
  - Forward Rate one year from now = 0.07
  - $P[0, t(k+1)] = \exp(-2 \times 0.07) = \text{Exp}(-0.14) = 0.86936$
  - volatility = 0.2
  - $d1 = -0.5677$
  - $d2 = -0.7677$
  - $N(-d1) = N(0.5677) = 0.7149$
  - $N(-d2) = N(0.7677) = 0.7787$
- Substituting the above values in equation 1 above, we get
- $V(\text{Floor let}) = \text{Rs. } 1.07 \text{ m}$

Each floor let of a floor must be valued separately using equ (1) and summed up to determine the value of the floor

Likewise the Black's model for valuing a caplet is given by the following equation

$$V(\text{Caplet}) = L * [t(k+1) - t(k)] * P(0, t(k+1)) * [R(k) * N(d1) - R(C) * N(d2)]$$

.... Equ (2)

Where  $R(C)$  denotes the cap rate which will be equal to the guaranteed rate of interest and all other symbols in this equation have been defined under Equ (1).

The following example illustrates the application of this formula:

**Example 2:** Continuing with the data provided in example 1, let us assume that the cap rate is 8% pa. Suppose we have to value the caplet starting one year from now.

$$\begin{aligned} \text{Given } d1 &= -0.5677 \\ d2 &= -0.7677 \\ N(d1) &= N(-0.5677) = 0.2851 \\ N(d2) &= N(-0.7677) = 0.2213 \end{aligned}$$

Substituting these values and the other values in equ (2) we get the V [Caplet] = Rs. 0.20 m.

This example drives home the fact that even though the current yield curve is flat at 7%, and the cap rate is 8%, the caplet has still got some value primarily because of the volatility parameter.

### **Application of the Option Pricing Framework:**

The inputs and the process involved in applying the Black's Model for valuing the interest rate guarantee are as follows:

#### **Inputs**

The inputs required for using the Black's model are as follows:

- The Gilt Yield Curve [the zero coupon yield curve applicable to Government of India Bonds] as on the valuation date
- The investment return earned on the assets backing the PF Accumulation for five to ten years immediately preceding the valuation date
- The current guaranteed rate of return ,which is typically equal to the rate of return declared by the Employees Provident Fund Organization [EPFO]
- The PF accumulation as on the Valuation Date
- The expected working life time of the members of the exempt provident fund as on the valuation date or such shorter period as the Actuary may consider to be appropriate
- The demographic assumptions related to decrements such as future attrition rates and mortality rates
- The discount rate which is equal to the market yield on Government bonds [on the balance sheet date] .The term of the Government bonds must be equal to the decrement adjusted expected working life time of the employees

#### **Process**

The following steps are involved in applying the Black’s Model for valuing the interest rate guarantee embedded in an exempt provident fund:

- Obtain the continuously compounded Zero Coupon gilt yield curve [as on the balance sheet date] over the “decrement adjusted” expected working lifetime of the members of the exempt provident fund or such shorter period as the Actuary may consider to be appropriate
- Derive the one-year forward rates from the Zero-coupon yield curve obtained in the previous step.
- Adjust the one-year forward rates for the yield spread between the portfolio rate of return and the yield on the gilts of an appropriate term. The portfolio rate of return refers to the rate of return on the asset portfolio backing the PF accumulation.
- Determine an appropriate volatility parameter for the spread adjusted one-year forward rates. This parameter can be estimated as the standard deviation of the historical rates of return on the asset portfolio backing the PF accumulation.
- Project the guaranteed rates of return based on the recent rate declared by the EPFO
- Use the Black’s Model for estimating the value of the floorlet for each year of the decrement adjusted remaining working life time. The value of the floor will be equal to the sum of the values of the floorlets.
- The PVO [Present Value Obligation] of the Interest Guarantee is equal to the value of the floor.
- The following table illustrates the application of this framework.

**Table 1: PVO of Interest Guarantee Using Black’s Model (Floor Only)**

<ul style="list-style-type: none"> <li>• Accumulated PF Balance: Rs. 500 m</li> <li>• Decrement Adjusted Average Working Life Time: 5 years</li> <li>• Yield Spread : 0%</li> </ul>					
<b>Year</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Zero Coupon Gilt Yields</b>	<b>8.15%</b>	<b>8.17%</b>	<b>8.19%</b>	<b>8.24%</b>	<b>8.32%</b>
<b>Spread Adjusted Forward Rates</b>	<b>8.15%</b>	<b>8.19%</b>	<b>8.25%</b>	<b>8.39%</b>	<b>8.60%</b>

<b>Volatility Parameter [% pa]</b>	<b>10%</b>	<b>10%</b>	<b>10%</b>	<b>10%</b>	<b>10%</b>
<b>Guaranteed Rate of Return</b>	<b>8.5%</b>	<b>8.5%</b>	<b>8.5%</b>	<b>8.5%</b>	<b>8.5%</b>
<b>Present Value of Floor lets (Rs. M)</b>	<b>1.60</b>	<b>2.19</b>	<b>2.38</b>	<b>2.30</b>	<b>2.08</b>
<b>Present Value of Floor (Rs. M)</b>	<b>10.55</b>				
<b>PVO of Interest Guarantee</b>	<b>10.55</b>				

If the PF Trust can retain the surplus interest earnings for funding future interest rate shortfalls, the Black's model needs to be modified to value the expected "excess interest earnings" which was earlier referred to as the value of the cap. In this case PVO of the interest rate guarantee will be equal to the difference between the value of the floor and the value of the cap.

The following table illustrates valuation of both floor and cap. This table assumes that the investment earnings in excess of the guaranteed rate are retained by the enterprise.

**Table 2**  
**Calculating the PVO using Black's Model (with both Floor and Cap)**

<ul style="list-style-type: none"> <li>• Accumulated Balance: Rs. 500 m</li> <li>• Decrement Adjusted Average Working Life Time: 5 years</li> <li>• Yield Spread : 0%</li> </ul>					
Year	1	2	3	4	5
<b>Zero Coupon Gilt Yield</b>	<b>8.15%</b>	<b>8.17%</b>	<b>8.19%</b>	<b>8.24%</b>	<b>8.32%</b>
<b>Spread Adjusted Forward Rate</b>	<b>8.15%</b>	<b>8.19%</b>	<b>8.25%</b>	<b>8.39%</b>	<b>8.60%</b>
<b>Volatility Parameter [% pa]</b>	<b>10%</b>	<b>10%</b>	<b>10%</b>	<b>10%</b>	<b>10%</b>
<b>Guaranteed Rate of Return</b>	<b>8.5%</b>	<b>8.5%</b>	<b>8.5%</b>	<b>8.5%</b>	<b>8.5%</b>
<b>Present Value of Floor lets (Rs. M)</b>	<b>1.60</b>	<b>2.19</b>	<b>2.38</b>	<b>2.30</b>	<b>2.08</b>
<b>Present Value of Floor (Rs. M)</b>	<b>10.55</b>				
<b>Present Value of Caplets (Rs. M)</b>	<b>0</b>	<b>0.84</b>	<b>1.40</b>	<b>1.91</b>	<b>2.42</b>
<b>Present Value of Cap (Rs. M)</b>	<b>6.57</b>				
<b>PVO of Interest Guarantee (Rs. M)</b>	<b>3.98</b>				